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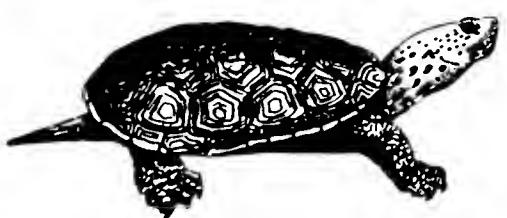
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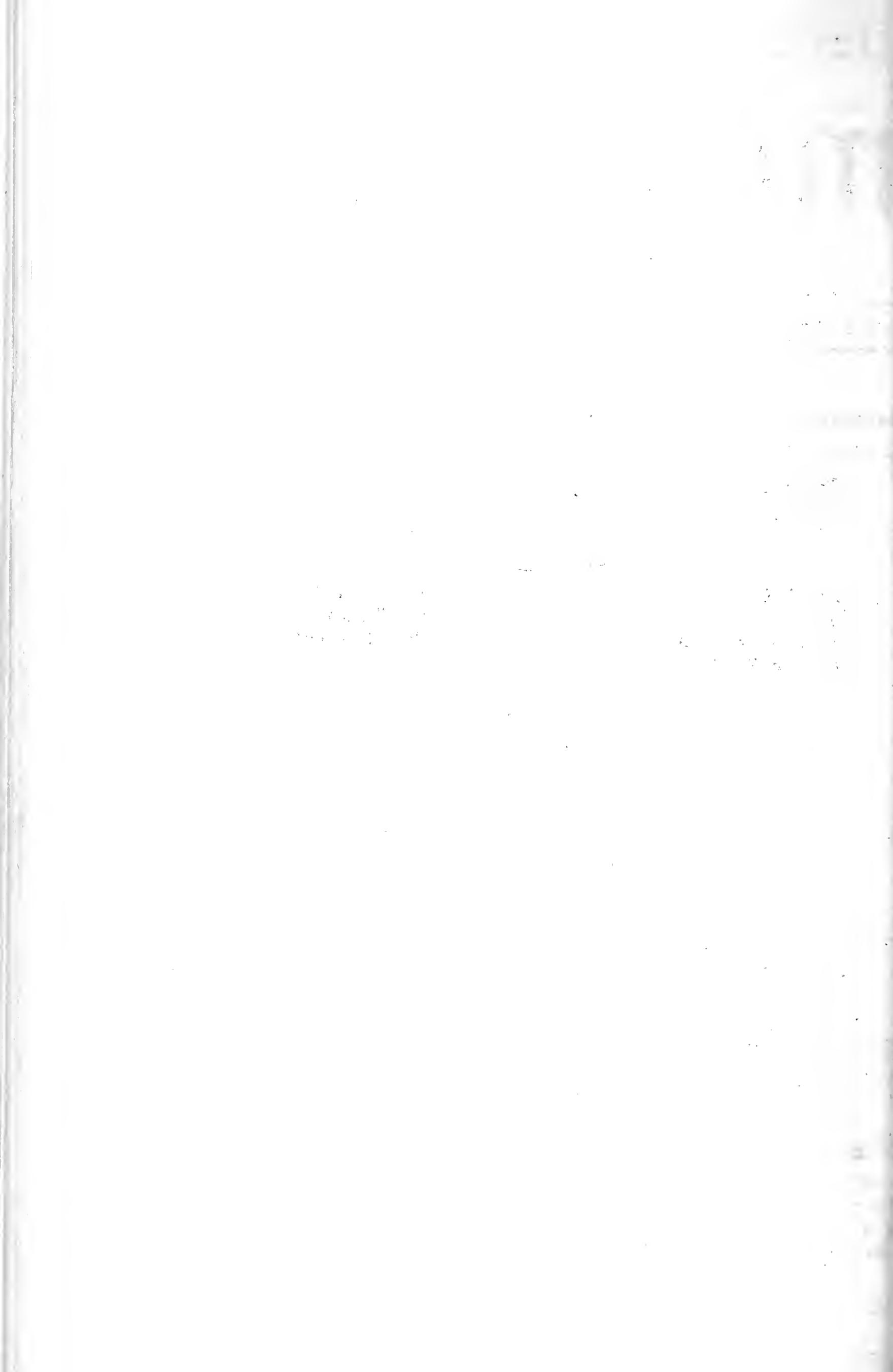
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## AN ANNOTATED CHECKLIST AND KEY TO THE SAUROFAUNA OF SOUTHEASTERN AND CENTRAL SPAIN

Achim R. Börner

This article was prepared as a hand-list for use in the field, when the author had the opportunity to spend a few days in southeastern Spain. It is primarily based on the checklist of Europe by Mertens and Wermuth (1960). The region covered by the present synopsis is delineated in Fig. 1. General literature on the region includes Hellmich (1956, 1962), Klemmer (1963), Mertens (1925), and Pasteur and Bons (1960).

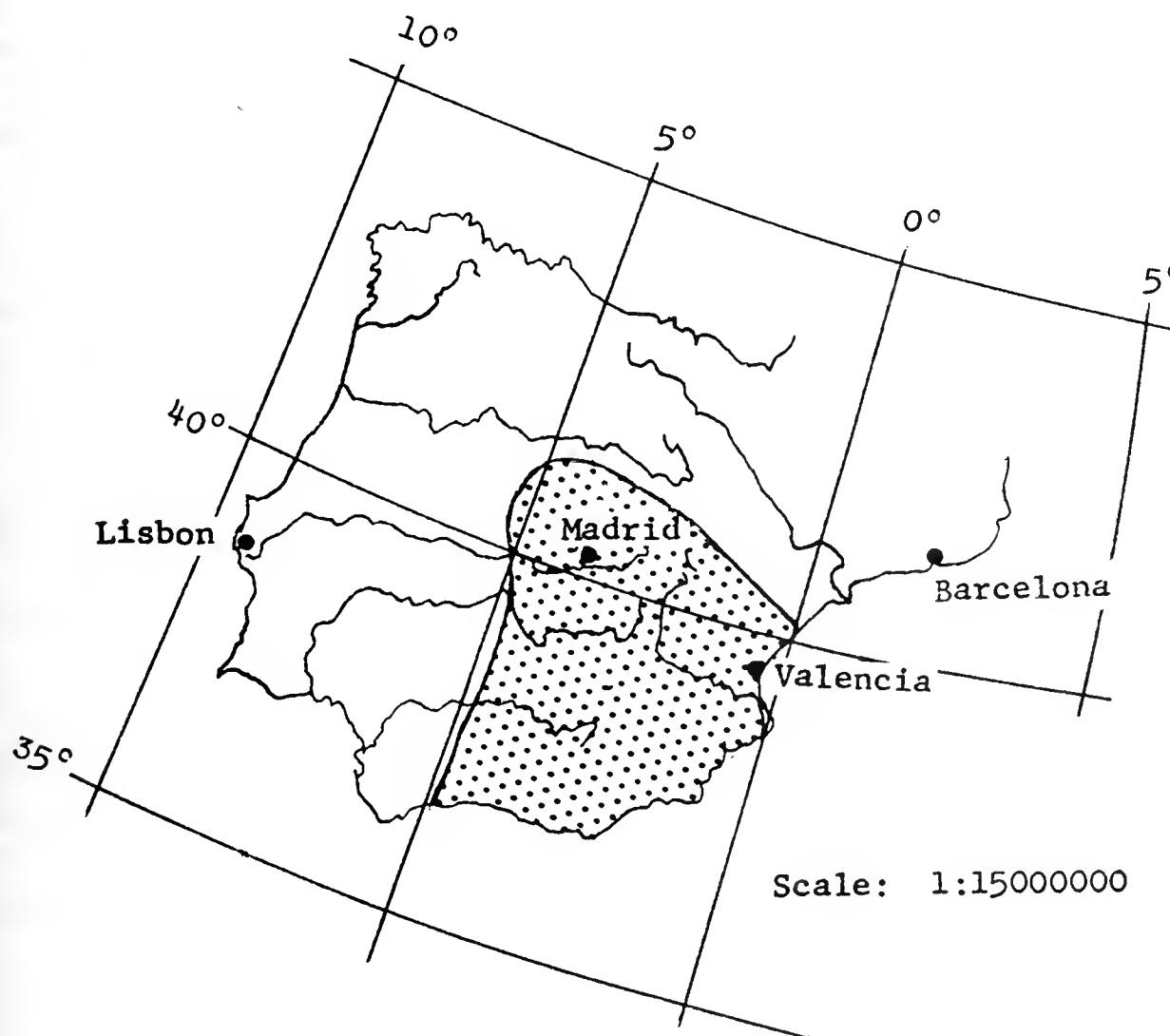


fig. 1 Map of Spain depicting the region under study.

## Annotated Checklist to the Saurofauna of Southeastern and Central Spain

## Anguidae

*Anguis f. fragilis* (LINNAEUS), 1758

Type locality: Sweden

## Chamaeleonidae

*Chamaeleo c. chamaeleon* (LINNAEUS), 1758

Type locality restricted by Mertens and Müller (1928): North Africa

The chamaeleon is said to be very rare in southern Spain and therefore should not be collected.

## Geckonidae

*Hemidactylus t. turcicus* (LINNAEUS), 1758

Type locality restricted by Schmidt (1953): Asian Turkey

*Tarentola m. mauritanica* (LINNAEUS), 1758

Type locality: Mauritania

An adult specimen typical of this Mediterranean gecko was found on a rock near the footpath from the lookout to the old harbour, Benidorm; it was taking a sunbath early in the morning.

## Lacertidae

This family, contributing the major element of the European saurofauna, is poorly known despite all of the efforts of European herpetologists and the tens of thousands of specimens amassed in museum collections. Since Boulenger (1920/1921) no one has undertaken the time consuming and painstaking job to attempt a revision of a larger subspecies, or species complex; the outstanding exception is the very few, however, who did not deal with the Spanish lizards such as Broadley (1972), Darevsky (1967), Eisentraut (1949), Lantz (1928/1930), and Peters (1962).

This chaotic situation, especially in the genera *Lacerta* and *Eremias* and their close allies, is reflected by our current knowledge of the Spanish forms; e.g. we know neither the number of wall lizard species nor their variation at the subspecific level. Therefore it is deemed necessary to give all names assigned to *Lacerta hispanica* in the region, although many are considered synonyms.

Genus *Acanthodactylus*

*Acanthodactylus e. erythrurus* (SCHINZ), 1833

Type locality: Spain

Genus *Algyroides*

All Spanish forms in this genus are rare. Their occurrence is sporadic, as they all require a high air-humidity. This is-

olation of populations effects subspecific diversity, which, due to the scarcity of specimens, is unknown. See Buchholz (1964) and Klemmer (1960) for additional data.

*Algyrooides hildagoi* BOSCA, 1916

Type locality: San Ildefonso, 1192 m elev., Sierra de Guadarrama, central Spain

Known only from the holotype, which apparently has been lost.

*Algyrooides m.marchi* VALVERDE, 1958

Type locality: Piedro de Aguamula, Sierra de Cazorla, Province of Jaén

*Algyrooides marchi niethammeri* BUCHHOLZ, 1964

Type locality: near the mountain pass (1480 m elev.) at ca. 1430 m elev., road from Alcaráz to Riópar, Sierra de Agua, Province of Jaén, southeastern Spain

Known only from the holotype.

Genus *Lacerta*

Additional data on the systematics of this group can be found in Buchholz (1963), Cyrén (1928, 1934), and Klemmer (1959).

*Lacerta hispanica* STEINDACHNER, 1870

It is not known, whether *Lacerta bocagei* SEOANE, 1844 is a distinct species or represents only a subspecies of *L. hispanica*. If it is indeed distinct on the specific level, a rearrangement of other subspecies, which are currently defined as *L. hispanica*, is warranted.

A female specimen, nearly 6 cm snout-vent length, from Isla de Benidorm (the island opposite to the famous hotel - town of Benidorm), and its habitat are depicted in the photos (figs. 2, 3, 4). The island is densely populated with lizards, whereas they are shy and very rare on the mainland (sight records exist from the mountains east of Playa Levante, Benidorm).

*Lacerta h. hispanica* STEINDACHNER, 1870

Type locality restricted by Mertens and Müller (1928): Monte Agudo near Murcia, southeastern Spain

*Lacerta muralis steindachneri* BEDRIAGA, 1886 was made a junior synonym of this race by Mertens and Wermuth (1960), who restricted its type locality to that of the nominate form. Klemmer (1959) was unable to find a single lizard at the type locality.

*Lacerta hispanica liolepis* BOULENGER, 1905

Type locality: town of Valencia, Spain

Described as a variety of *L. muralis*, it was then referred to *L. bocagei*, and later reduced to a junior synonym of the nominate species.



fig. 2 *Lacerta hispanica*, adult female from Isla de Benidorm

*Lacerta hispanica vaucheri* BOULENGER, 1905

Type locality: Tanger, northwest Africa

The lizards in the extreme south of Spain are referred to this race, which is considered valid.

*Lacerta hispanica guadarramae* BOSCA, 1916

Type locality: San Ildefonso, Sierra de Guadarrama, central Spain

This name is tentatively considered a junior synonym of the nominate subspecies.

*Lacerta l. lepida* DAUDIN, 1802

Type locality restricted by Mertens and Wermuth (1960): southern France

*Lacerta lepida nevadensis* BUCHHOLZ, 1963

Type locality: North-slope of the Pico Veleto, between 1600 m and 2100 m elev., Sierra Nevada, south Spain

*Lacerta monticola cyreni* Müller & Hellmich, 1937

Type locality: Puerto de Navacerrada, Sierra de Guadarrama, Spain.

*Lacerta sicula* ssp.

introduced in Almería according to Mertens and Wermuth (1960)

Genus *Psammodromus*

*Psammodromus a. algirus* (LINNAEUS), 1758

Type locality: Mauritania

Ash-gray specimens were observed on the walls and in the gardens of Almería Castle, Almería. Normally the back has a brownish or olive color.

*Psammodromus h. hispanicus* FITZINGER, 1826

Type locality restricted by Mertens and Müller (1928): Southern Spain.

*Psammodromus hispanicus edwardsianus* (DUGES), 1829

Type locality: Southern France

The zone of intergradation between both subspecies is of special interest. Studies in this zone may reveal the distinctiveness of the forms on the specific level.

#### Scincidae

For the systematics of this group see Klausewitz (1954) and Pasteur and Bons (1960).

*Chalcides bedriagai* BOSCA, 1880

Type locality restricted by Mertens and Müller (1928): Dos-aguas, Valencia

*Chalcides chalcides striatus* (CUVIER), 1829

Type locality: Southern France

The validity of this form requires further examination.



fig. 3 Lizard habitat on Isla de Benidorm

Artificial Key to the Saurofauna of Southeastern and Central Spain

1. Limbless . . . . . *Anguis f. fragilis*
1. Limbs present . . . . . 2
  2. Underside of toes with transversely enlarged lamellae (scissors)
    - 3 (Geckonidae)
  2. Digits in two opposable sets of 2 and 3
    - Chamaeleo c. chamaeleon
  2. Digits not so, separate . . . . 4
    3. Underside of digits with one row of scissors
      - Tarentola m. mauritanica
    3. Underside of digits with two rows of scissors
      - Hemidactylus t. turcicus
  4. Ventral scales not differentiated
    - 5 (Scincidae)
  4. Ventral scales well differentiated from the dorsals
    - 6 (Lacertidae)
  5. Limbs reduced, each with three digits
    - Chalcides chalcides striatus*
  5. Limbs relatively well developed, each with five digits
    - Chalcides bedriagai*
  6. Pileus without an occipital; only two supraoculars
    - Acanthodactylus e. erythrurus*
  6. Pileus with an occipital; four supraoculars
    - 7
  7. Dorsal scales large, rhombic, relatively strongly keeled, imbricate . . . . . 8
    - 7
  7. Dorsal scales small, rounded, weakly keeled or not keeled, not imbricate . . . . . 13 (*Lacerta*)
  8. Ventral scales squarish; well differentiated collar scales
    - 9 (*Algyroides*)
  8. Ventral scales rhombic; collar scales discernible only on the sides of the throat . . . . . 11 (*Psammodromus*)
  9. Dorsum uniformly brownish with vague dark spots on the vertebral line; dorsals sharply keeled; 17 rows of dorsals around the middle of the body . . . . . *Algyroides hildagoi*
  9. Middle of dorsum light brown with sharply defined spots on the vertebral line; sides of the trunk dark brown; dorsals not so sharply keeled; 24 to 31 rows of dorsals around the middle of the body . . . . . 10 (*Algyroides marchi*)
  10. 24 to 29 dorsals around the middle of the body; throat whitish or yellow . . . . . *Algyroides m. marchi*
  10. 31 dorsals around the middle of the body; throat deep blue (only in adult males?) . . . . . *Algyroides marchi niethammeri*
  11. On each side of the back a longitudinal yellow stripe; length of unregenerated tail doubles snout-vent length, which exceeds 7 cm
    - Psammodromus a. algirus*
  11. Longitudinal stripes only as juveniles: 4 to 6 of them along the back, composed of light spots; adults uniform or with dark spots; length of unregenerated tail never exceeds double snout-vent length; snout-vent length does not exceed 5 cm
    - 12 (*Psammodromus hispanicus*)

12. 30 to 34 dorsals around the middle of the body; subocular reaches the mouth; greenish in life . . . *Psammodromus h. hispanicus*

12. 34 to 43 dorsals around the middle of the body; one or two small scales separate the subocular from the mouth; not greenish . . . . . *Psammodromus hispanicus edwarsianus*

13. Ventral scales like a trapezium . . . . . 14 (*Lacerta lepida*)

13. Ventral scales squarish . . . . . 15 (wall lizards)

14. 65 to 70 dorsals around the middle of the body; ocellated, black scales irregularly distributed . . . . . *Lacerta l. lepida*

14. 76 to 90 dorsals around the middle of the body; ocelli faded, no black scales . . . . . *Lacerta lepida nevadensis*

15. Dorsals at least weakly keeled; scales of unregenerated tail in distinct whorls, broad and small ones alternating . . . . . *Lacerta monticola*

15. Dorsals not keeled; scales of unregenerated tail in whorls of equal length . . . . . 16

16. Underneath uniformly colored, except the outer rows of the ventral scales; differentiated large temporal (massetericum) . . . . . *Lacerta sicula*

16. Underneath black spots, at least on the throat; massetericum normally missing . . . . . *Lacerta hispanica*



fig. 4 Isla de Benidorm, seen from the mainland

#### Acknowledgements

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## GRIST FOR THE MILLS OF HERPETOPHILES IN MEXICO

Hobart M. Smith

The limitless opportunities for new discoveries in the amazingly complex diversity of the herpetofauna of Mexico cannot be catalogued. The cream has been skimmed from the basic work of faunal exploration, as noted several years ago by one of the greatest herpetologists of our country, W. E. Duellman, even though new taxa, significant range extensions and taxonomic rearrangements will continue to be discovered frequently for many years, and occasionally for many decades. Every new road makes accessible many such discoveries. Nevertheless the fact remains that the alpha phase of basic exploration is no longer dominant; now the experimental and observational phase is rapidly developing, with emphasis in the field upon behavioral and demographic studies, which have gained a great advantage over the strict collecting of the alpha phase through the imposition of severe regulations curbing wanton collecting and importation of amphibians and reptiles.

One of the most exciting prospects for field observation in Mexico at this particular time is the determination of the basic facts in the life cycle of the high-altitude lizard *Sceloporus aeneus aeneus*, common in the mountains between Mexico City and Cuernavaca, and occurring rather widely elsewhere in the southern mountains of the main Mexican plateau. It would be a simple, delightful and rewarding experience, especially for a family, justifying protracted or repeated stays in Cuernavaca or some other strategically situated base (see Fig. 1) near the range of this subspecies, to launch an investigation to settle once and for all the basic questions of the life cycle of this lizard.

It would take an outstandingly significant problem to justify such a proposition, but the qualification exists. There is an outside chance that *S. a. aeneus* may prove to be the only lizard in the world known to reproduce in alternate years. This is the problem for the solution of which so far there is nothing but speculation, but which could be solved by even one, and certainly by two, appropriately chosen, brief periods of observation.

Even such a basic matter as method of "parturition" (i.e., by parturition or oviposition) remains to be established in this subspecies. Such information does not come easily, for the critical period usually arrives in spring when human collectors are occupied with other matters, such as a fixed schedule of work or school; when they are free, in summer, it is too late for immediately conclusive evidence to be obtained. Only in 1962 (Anderson) was it demonstrated that the only related member of the group occurring in this country (*S. scalaris slevini*) is oviparous. It was established long ago that *S. scalaris scalaris* is oviparous (Herrera, 1890:

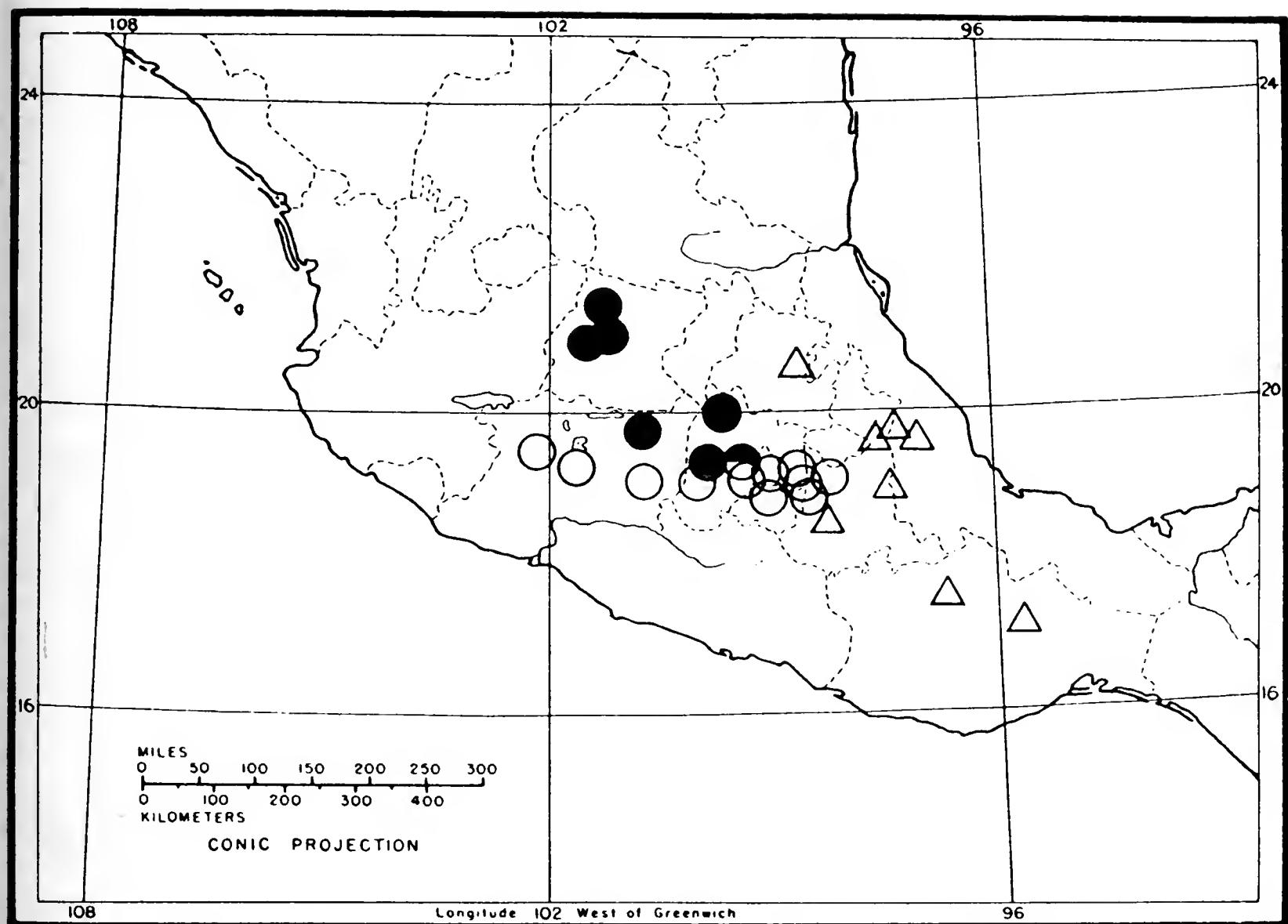


Fig. 1. Localities recorded for the three subspecies of *Sceloporus aeneus*. Triangles, *S. a. bicanthalis*; circles, *S. a. aeneus*; dots, *S. a. subniger*; half-circle, half-dot, intergrades between *S. a. aeneus* and *S. a. subniger*. Adapted from Zool. Ser. Field Mus. Nat. Hist., 26:357, fig. 57, 1939.

331), and in 1939 Smith (1939:356) recorded that *S. aeneus bicanthalis* is viviparous.<sup>1</sup> Gadow (1905:214) stated that *S. scalaris* is "ovoviviparous," but clearly in error, probably in reference in reality to either *S. a. aeneus* or *S. a. bicanthalis*. This is the only reference even possibly noting method of parition in *S. a. aeneus*, and these are the only taxa of the whole *scalaris* group for which such information had been recorded, until 1974 when Smith and Hall recorded the occurrence of viviparity in *S. goldmani*. They went on however to propose that viviparity is the norm in all subspecies of *S. aeneus* as well as in *S. goldmani*, and that all subspecies of *S. scalaris* are oviparous, leaving in abeyance the parition method of the only other assigned member of the group, *S. jalapae*. Such a proposition required however that they really crawl out on a limb to propose that *S. a. aeneus* normally reproduces biennially.

<sup>1</sup> Viviparity is a term here used, as it should always be to avoid confusion, in its broadest sense in reference merely to live-bearing, without implication of presence or absence of a placenta, rudimentary or not. Ovoviviparity is a type of viviparity in which placental structures

That proposition stems from the proposal by Davis and Smith (1953: 102) that *S. a. aeneus* is oviparous, thereby requiring specific status since *S. a. bicanthalis* is incontrovertibly viviparous. The data on which the inference of oviparity was based were summarized as follows: "Ten of the 28 females, collected from July 25 to August 15, contained from 3 to 5 (average, 4) large ova, the largest measuring 6 X 12 mm; 12 of the others appeared to have oviposited and in the others the ova were minute, less than 1 mm in diameter. In none of the large ova was there any recognizable evidence of embryonic development." The assumption was, of course, that the females with no or minute eggs had already laid their eggs, whereas those with large eggs would have laid them later in the same season.

In more mature consideration, however, it is evident that eggs in which no visible embryonic development had yet taken place could not be laid after mid-August and still hatch before winter. The altitude (around 3,330 m) and normal weather pattern preclude rapid development; even in midsummer, nights are unpleasantly cold, and freezing weather comes early. Winter snows are commonplace. It now seems more reasonable to infer that the females with large eggs would have carried them over winter and have given birth to their young in late spring and early summer. They would have redeveloped small eggs by fall, duplicating the members of the group described by Davis and Smith with small eggs. The eggs would have reached larger size by the fall of the following year, and the young would have been born the following spring and summer.

Although available data suggest the possible validity of the hypothesis of occurrence of a biennial reproductive cycle in *S. a. aeneus*, at least in the Tres Cumbres area of Morelos, three considerations suggest contrariwise: (1) no lizard anywhere in the world has been recorded to have a biennial cycle, according to Fitch (1970), although several northern species of snakes (e.g. *Crotalus viridis*, *Vipera berus*, *V. aspis*, *Thamnophis sirtalis*, *T. radix*) are known or thought to have either biennial or triennial cycles (Fitch suggests that the extended cycles are better interpreted as irregular cycles); (2) lizards, especially small *Sceloporus*, are too short-lived for a biennial cycle, especially of viviparity, to sustain the species (the snakes are much longer-lived); and (3) other species of lizards under apparently equally great or greater environmental stress maintain an annual cycle.

are present. Histological examination is necessary to determine whether any given viviparous species is ovoviviparous or euviviparous, and even then the distinction may be argumentative. Except where histological study has confirmed the presence or absence of a placenta - and very few species of reptiles have been studied in this context - it is best always to use the term of broadest meaning in reference to non-mammalian vertebrates, since only in the viviparous mammals is a placenta assured.

The alternative to viviparity is, of course, oviparity. These two types, and their subtypes, if any, constitute the parity types, the term parity occurring with this meaning in most dictionaries. The act of parity, i.e. of laying eggs or giving birth, is properly referred to as "parition" (a new word), and the condition of parity is properly referred to as the "parous" condition (an established word).

Obviously the mere fact that no lizard is yet known to have an extended reproductive cycle is inconsequential except as it makes the establishment of such species of exceptional interest. As for the longevity of *S. a. aeneus*, nothing is known, but an extrapolation from data on related and other small species of lizards suggests a life span almost certainly not exceeding 10 years, and quite likely not frequently exceeding 5 years. Northern species in general, however, subjected as they are to cold-induced inactivity much of the year, are longer-lived and have more protracted reproductive cycles than do their more temperate relatives. The same generality may apply equally well to high altitude species as compared with their lower-altitude relatives.

Finally, although several other species of iguanid lizards reach altitudes considerably greater than does *S. a. aeneus*, all so far as I am aware are conspicuously heliophilous, insulating extensively on trees or rocks. Some high-altitude lizard populations may indeed have polyennial reproductive cycles, for they have not been observed exhaustively; on the contrary northern lizard populations have been studied thoroughly and seemingly do not deviate from the norm of annual reproductive cycles. However, it is quite possible that through extreme heliophily most high-altitude lizards so protract their activity that an annual reproductive cycle may be maintained. An example is the sympatric (with *S. aeneus*), viviparous *S. grammicus microlepidotus*, which ranges to a much higher altitude (4750 m) than *S. aeneus*, but is strongly heliophilous and seemingly reproduces annually.

On the contrary, *S. a. aeneus* is not given to conspicuous insolation, but is secretive, terrestrial and graminicolous, thus exposed to the maximum developmental retardation of the cold weather characteristic within its range. Even if it were known to have a lower optimum activity temperature (not established, but possible) than other sympatric species, it would not necessarily thereby escape the need for a biennial cycle; *Sphenodon*, with the lowest optimum activity temperature of any living reptile, has a protracted reproductive cycle ( $\pm$  13 mo.), although its freedom from temperatures in the freezing range permits a more rapid development of embryos than would be possible in the strongly seasonal weather to which *S. a. aeneus* is exposed. *Sphenodon* in the habitat of *S. a. aeneus* would probably also require two years for completion of one reproductive cycle.

Thus the facts of the reproductive cycle, longevity and population structure of *S. a. aeneus* stand as one of the most rewarding goals toward which any herpetologist may work in Mexico. Unlike many problems, these have answers that are readily accessible, awaiting merely the determined attention of anyone willing to devote a little time and effort to them.

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# THE GREEN TURTLE (*CHELONIA MYDAS*), ONE OF THE REPTILES MOST CONSUMED BY MAN, NEEDS IMMEDIATE PROTECTION

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## ABSTRACT

A description of the biology of *Chelonia mydas* (Linnaeus) 1758, is given, including the problems concerning the preservation of this economic and valuable sea turtle. Its decline, classification, distribution, sub-speciation, characteristics, size, weight, color, food, mating behaviour, eggs, hatchlings, enemies and turtle hatcheries are discussed.

## DECLINE

One and a half centuries ago a biologist wrote: "..... this species of turtle is one of the most valuable gifts of providence to the inhabitants of tropical climates, and to sailors frequenting those climates. It affords them an abundant supply of agreeable and nutritive food. So numerous are they in some places that 40 to 50 specimens have been obtained within 3 hours". The favoured reptile he wrote about was *Chelonia mydas*, the now well known green turtle, also called edible turtle.

Labat (1725) was one of the first authors describing a favoured meal for Europeans living in the Caribbean in those days. The meal was composed of the chopped meat of two marine turtles, mixed with hard-boiled egg yolks, the greenish fat of one turtle, herbs and spices, the whole smothered above a fire, using the carapace of one of the dead turtles as a pan. He writes: "..... a king never tasted a daintier pastel .....". In this way the fame of turtle meat reached Europe and North America, and thousands of animals were killed every month. Before man started eating turtle meat in great quantities, it was known that from the greenish fat of one species (hence "Green Turtle") a delicious soup could be prepared. With the colonization of the New World by Europeans, a spectacular decline in turtle numbers began. During that time the Caribbean was the major source of turtles for use as food in other parts of the world. This led to the first protective legislation, which was passed in Bermuda in 1620. The killing of turtles was prohibited if the width of the animal's carapace was less than 18 in (45 cm) (Brongersma, 1964). In spite of this the decline of turtles around Bermuda continued. In the early 17th century the crew of two vessels could secure as many as 40 green turtles in one day; in 1933 two steamers with experienced turtle-hunters could seize only 24 reptiles in 4 months (Babcock, 1938). Not only the animals were wanted as an important source of protein by coastal people, but also their eggs. Between 1932 and 1936, 2,184,095 eggs were dug up on an average every year on three islands offshore of Sarawak (Harrison, 1962). Eggs are currently consumed today in Thailand, Indonesia, Burma, Borneo and the southern Philippine Islands (Hirth, 1971). Turtles once nested in large numbers on the coasts of eastern Africa, but are now rare, probably because of egg-collecting.

To the demand for turtle soup and the demand for their meat can be added the demand for their leather, which became very fashionable in past decades. The United States Department of the Interior (Fish and Wildlife Service) recently published a list of amphibians and reptiles imported into the United States in 1970 and 1971 (Busack, 1974). From this leaflet one can learn that at least 293 (1970) and 613 (1971) living *Chelonia mydas* were imported. From the same leaflet the following summary of green turtle products imported into U.S.A. is derived (Table 1.).

Table 1. Summary of Green Turtle Products Imported into the U.S.A. During 1970 and 1971.

year	shoes	skins, pieces	meat (1bs)	calipee (1bs)	oil (1bs)
1970	0	2200	113,900	25,195	2500
1971	74	3302	87,000	0	0

Herpetologists all over the world agree that the green turtle (and other marine turtles) needs protection. Governments in several countries proposed regulations for the hunting and/or killing of sea turtles and for collecting their eggs. In some cases full protection of the turtles and their eggs were given. In other countries adults and clutches are protected only during certain seasons. The fact remains that green turtles are not as common today as they once were. A few examples for their decline were given, but many more could have been mentioned. The green turtle has nearly disappeared altogether in many places on beaches of tropical and subtropical seas. One reassuring thought is that the demand for meat and soup is decreasing, especially in Europe. However, a relative of mine, mentioned that his son played with skeletons of green turtles (?) on the beach near Colombo, when he lived at Sri Lanka (formerly Ceylon) during 1968 and 1969. The animals were captured at sea and slaughtered on the beach close to restaurants where the meat and soup were served. A similar incident is also mentioned by Rose (1950). The carapaces and plastrons were left and used by children to play hide-and-seek. The beach was dotted with turtle remains.

This article is intended as a contribution towards the conservation of *Chelonia mydas* and to bring to the attention in a nutshell to both biologists and laymen the facts currently known concerning this remarkable and ancient reptile. It may be regarded as a sequel to my article (1974) on the Leatherback (*Dermochelys coriacea*), and will be followed by other articles on marine turtles in the future.

## CLASSIFICATION, DISTRIBUTION AND SUBSPECIATION

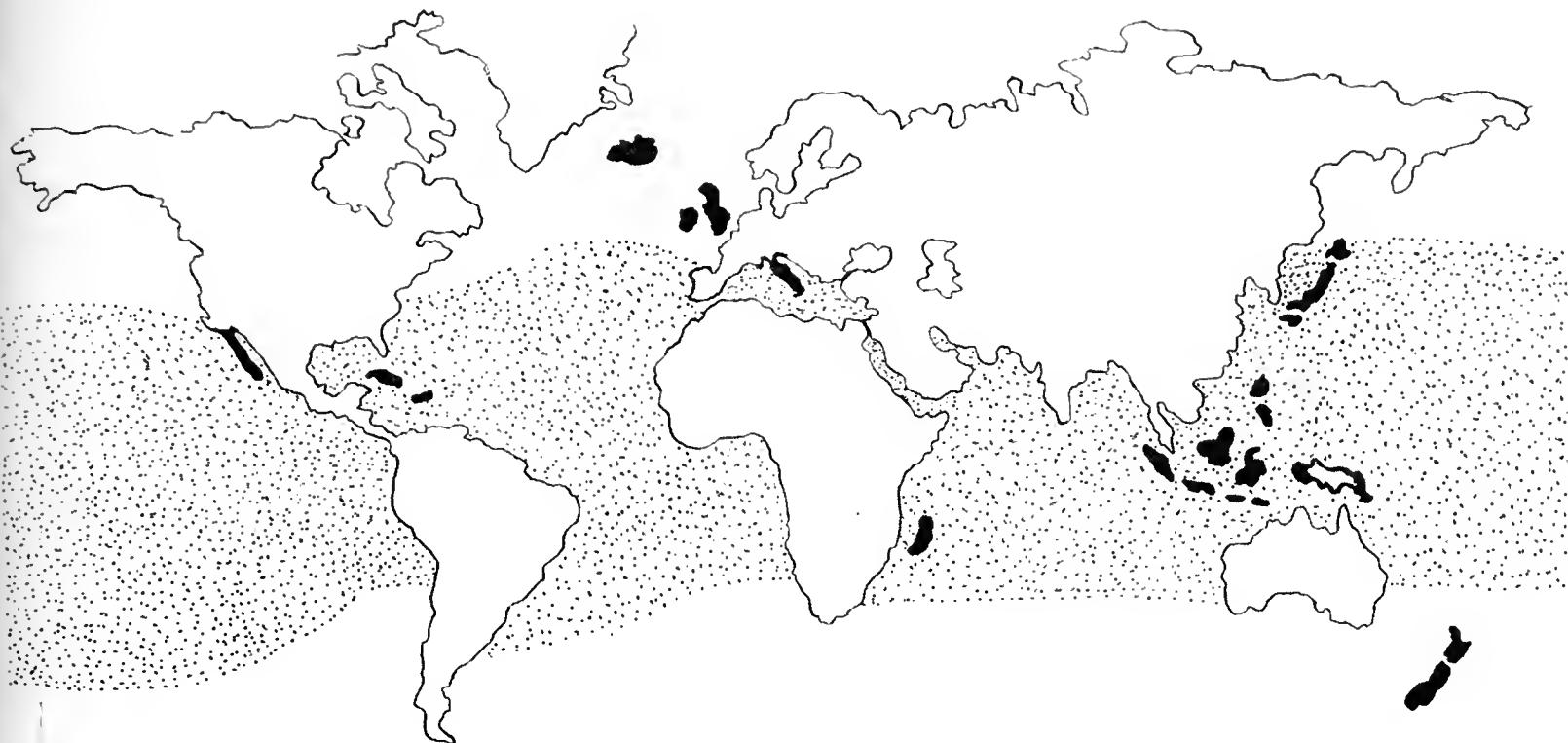


Fig. 1. The distribution of *Chelonia mydas*.

*Chelonia mydas* and five other species of sea turtle belong to the family Cheloniidae, which in turn with the family Dermochelidae form the superfamily Chelonoidea of the order Testudinata. The species was first described as *Testudo mydas* in 1758 by the famous Swedish naturalist Linnaeus (type locality Ascension Island in the Atlantic Ocean). In 1800 the generic designation *Chelonia* was introduced by Bronniart. Since that time, specimens of the green turtle have often been mistaken for a new species and described as such. The list of names in the synonymy of *C. mydas* has become quite long.

*C. mydas* lives in shallow waters, mostly in coastal areas, far from its breeding grounds. It wanders through all tropical seas, since at regular intervals it travels to sandy shores to lay eggs. Between the feeding grounds and breeding grounds may lie hundreds of miles of open sea; specimens tagged at Ascension Island were recaptured near the coast of Brazil, about 2200 kilometers away (Cronnie, 1971).

The green turtle is usually found within 35 degrees north and south of the equator (Loveridge, 1946). It prefers seas with an average temperature of surface water during the coldest month of above 20° C (Hirth, 1971). However, wanderers are seen or caught at more northerly points (e.g. in Newfoundland waters, near British Columbia and Japan). The southernmost records are from coastal areas of northern Argentina, Chile and New Zealand. There is considerable variation in the color of green turtles, which has resulted in the description of a number of subspecies. Hirth (1971) recommends the use of the binomial *Chelonia mydas* for all green turtles until a detailed taxonomic study can be made. Brongersma (1964) is also of the opinion that a detailed study ought to be made, before valid subspecific identification is possible. He noted that such a study would be difficult and time consuming. There are, however, a number of indications

which make it plausible that the green turtle can be divided into a few subspecies. Bustard (1973) indicates that a number of well-differentiated populations exist and what is currently called the 'green turtle' could prove to be a composite of two or more quite distinct species.

In general the following subspecies are recognized:

*Chelonia mydas mydas* (Linnaeus), the Atlantic green turtle, found in the Atlantic Ocean, Caribbean Sea, Gulf of Mexico and the Mediterranean (Conant, 1958; Mertens and Wermuth, 1960; Hirth, 1971).

*Chelonia mydas agassizii* Bocourt, the east Pacific green turtle, found mainly along the Pacific coasts of Central and South America (Hirth, 1971; Stebbins, 1966).

*Chelonia mydas carri*negra Caldwell, the northeastern Pacific green turtle, occurs in great numbers in the Gulf of California. This subspecies was described in 1962 by D.K. Caldwell. Other herpetologists (Hirth and Carr, 1970; Pritchard, 1971) have since concluded that this dark form was nothing more than a sterile mutant form of *C.m. agassizii*. Schulz (1968) does not recognize this subspecies.

*Chelonia mydas japonica* (Thunberg), the western Pacific green turtle, probably only living near Japan and ranging as far east as the Hawaiian Islands. Worrell (1963) lists it as a full species for Australian waters (*Chelonia japonica*), and gives the range as Pacific and Indian Oceans. He mentions that there is a nesting site near Bundaberg (Queensland). It is likely that this species should be placed in the synonymy of *Chelonia depressa*, described by Garman in 1880 and the least known of the world's sea turtles. *Chelonia depressa*, the flatback turtle, breeds on the coast and islands offshore of northeastern Queensland, and is often mistaken for a green turtle. The flatback differs mainly in having a strongly depressed carapace with an upward curve at the edge (Bustard and Limpus, 1969).

## CHARACTERISTICS

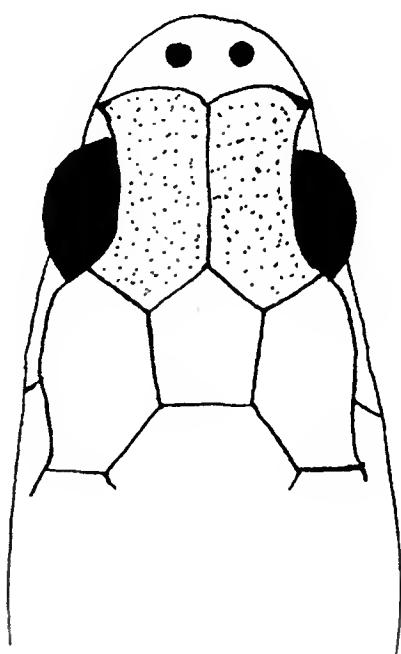


Fig. 2. The characteristic large prefrontal plates of *Chelonia mydas*.

The carapace of *C. mydas* is not completely ossified; it is smooth and has 4 costal shields (costals) on each side, the 1st not touching the nuchal. The other horny shields of the carapace are: 2 supracaudals, 11 marginals on each side and 5 vertebrals. The large scutes of the carapace do not overlap, except in very young turtles. The fore-flippers only bear a single claw. The jaws are not so remarkably hooked as in *Dermochelys coriacea*. The cutting edge of the lower jaw is coarsely toothed (Fig. 3), while the



Fig. 3. The head of *Chelonia mydas* ♀.

upper jaw is provided with strong ridges on its inner surface. Between the eyes a pair of large prefrontal plates are visible (Fig. 2). Males can be recognized by their tail, which is much longer than in females. Moreover their carapace is somewhat narrower and longer. Fig. 4 shows the tail of a male caught on Eilanti (Surinam); it has a length of 38 cm (Schulz, 1968). The tail of the male is very muscular and tipped with a horny nail (Fig. 5). Stebbins (1966) mentions that males have a prehensile tail. In their paper on the behaviour of green turtles in the sea, Booth and Peters (1972) print a number of photos clearing up mating behavior. Some of the photos show that during mating the male's tail is curled around the back-side of the female's body (her hind flippers ?), to give him a firmer grip.



Fig. 4. The tail of a male *Chelonia mydas*.



Fig. 5. The male's tail is tipped with horny nail.

#### SIZE AND WEIGHT

While the shell of a large green turtle may be almost 4 ft (120 cm) in length, 3 ft (90 cm) is nearer the average for an adult; a turtle was once taken at Key West (Florida) weighing 700 lbs (315 kg). Those appearing in the American markets today range from 75 lbs (33.5 kg) to 150 lbs (67.5 kg) (Loveridge, 1946). In Surinam the carapace length ranges from about 40 in (100 cm) to 50 in (125 cm) (Schulz, 1968). Deraniyagala (1953) mentions curved carapace lengths of about 48 in (122 cm), which are not uncommon at Sri Lanka. Pritchard (1971) gives the following carapace lengths of mature females: Galapagos Islands from 28.5 in (72 cm) to 37 in (94 cm), Surinam 39 in (99 cm) to 48 in (122 cm), Ascension Island 33 in (84 cm) to 55 in (140 cm), in Guyana from 38 in (96.5 cm) to 46 in (117 cm), and in Costa Rica from 35 in (89 cm) to 44 in (112 cm). Two adult males in the Galapagos had carapace lengths of 31.5 in (80.0 cm) and 33.2 in (84.3 cm).

Worrell (1963) mentions a maximum weight of about 850 lbs (382 kg) for Australia, but the results of turtle-hunters indicates that specimens over about 250 lbs (112.5 kg) are quite rare. In November 1952 a green turtle was stranded on the Dutch coast, which is very uncommon for temperate areas; the carapace was only 14 in (36 cm) long and 11.5 in (29.5 cm) wide (Brongersma, 1961). Undoubtedly, it was a juvenile. Hirth and Carr (1970) give some sizes of green turtles caught on the feeding pastures near Khor Umaira, southern Yemen; the carapace lengths of 178 females ranged from 29 in (48.3 cm) to 44 in (111.8 cm) - average 34.7 in (88.1 cm). The carapace lengths of 112 males ranged from 28 in (71.1 cm) to 41 in (104.1 cm) - average 35.6 in (90.4 cm).

The heaviest green turtle ever reported, weighed 860 lbs (386 kg). Almost half of the wet weight of a green turtle represents edible protein (Hirth, 1971).



Fig. 6. Female *C. mydas* crawling up on a beach.

## COLOR

There is a considerable variation in color, as previously mentioned. Therefore, for purposes of identification a color description of the turtle will never be enough. In his synopsis on the green turtle, Hirth (1971) gives the following description of the coloration of the various subspecies:

*Chelonia m. mydas* has a predominately brownish carapace, sometimes with olive or dark brown blotches and streaks. The dorsal surfaces of the head, flippers and tail are also predominately brownish.

*C. m. agassizii* has a basically greenish or olive-brown carapace sometimes strongly flecked with black.

*C. m. carrinegra* is characterized by black pigmentation on both dorsal and ventral surfaces (plastron more greyish).

*C. m. japonica* (from Philippines waters) is rusty reddish brown above, each shield streaked with amber, head shields distinctly reddish and each edged with black, plastron yellow. Around Thailand waters this subspecies is greenish to greyish above, specimens with dark rays are observed as well; the plastron is yellow.

In the Galapagos two color forms exist, a pale (called 'yellow' turtle) and a dark form. The latter nests on several islands, but the yellow has never been seen nesting there. In both forms the plastron always has variable grey areas on the sides and along the midline. According to Pritchard (1971) both forms belong to the subspecies *C. agassizii*.

These are only a few of the number of green turtle "forms" existing. It appears that coloration is highly variable. Besides, there also seems to be color differences between males and females. In a few cases this has been indisputable ascertained. Not only in the Atlantic Ocean and Mediterranean, but also throughout the Pacific Ocean and the Indian Ocean and the Indian Ocean an unknown number of races exist. Careful research (as soon as possible) will indicate into how many races (separate species ?) *Chelonia mydas* can be divided. It is possible, that some races will become extinct in the near future, if no protective measures are taken. Efforts should be made so that each race survives.

## FOOD

It can be stated that adult and sub-adult green turtles are mainly herbivorous, while the young (1 to 2 years old) are carnivorous (Schulz, 1968). The main diet of adults consists of sea grasses, the so called "turtle grass", that grow in sheltered shallow water. Submarine pastures near coastal areas and on atolls are visited by the turtles at selected places throughout the year. The stomach contents of over 100 turtles, caught near Khor Umaira (Southern Yemen), were examined and it appeared that two types of turtle grass, *Posidonia* sp. and *Halodule* sp., form the menu. Also a small amount of brown algae and red algae were found (Hirth and Carr, 1970). The stomach of 6 mature turtles (5 ♀, 1 ♂) packed solidly with this grass, weighed between 3.9 lbs (1.8 kg) and 5.5 lbs (2.5 kg). The densities of turtle grass (*Posidonia*) reach 2500 leaves per square

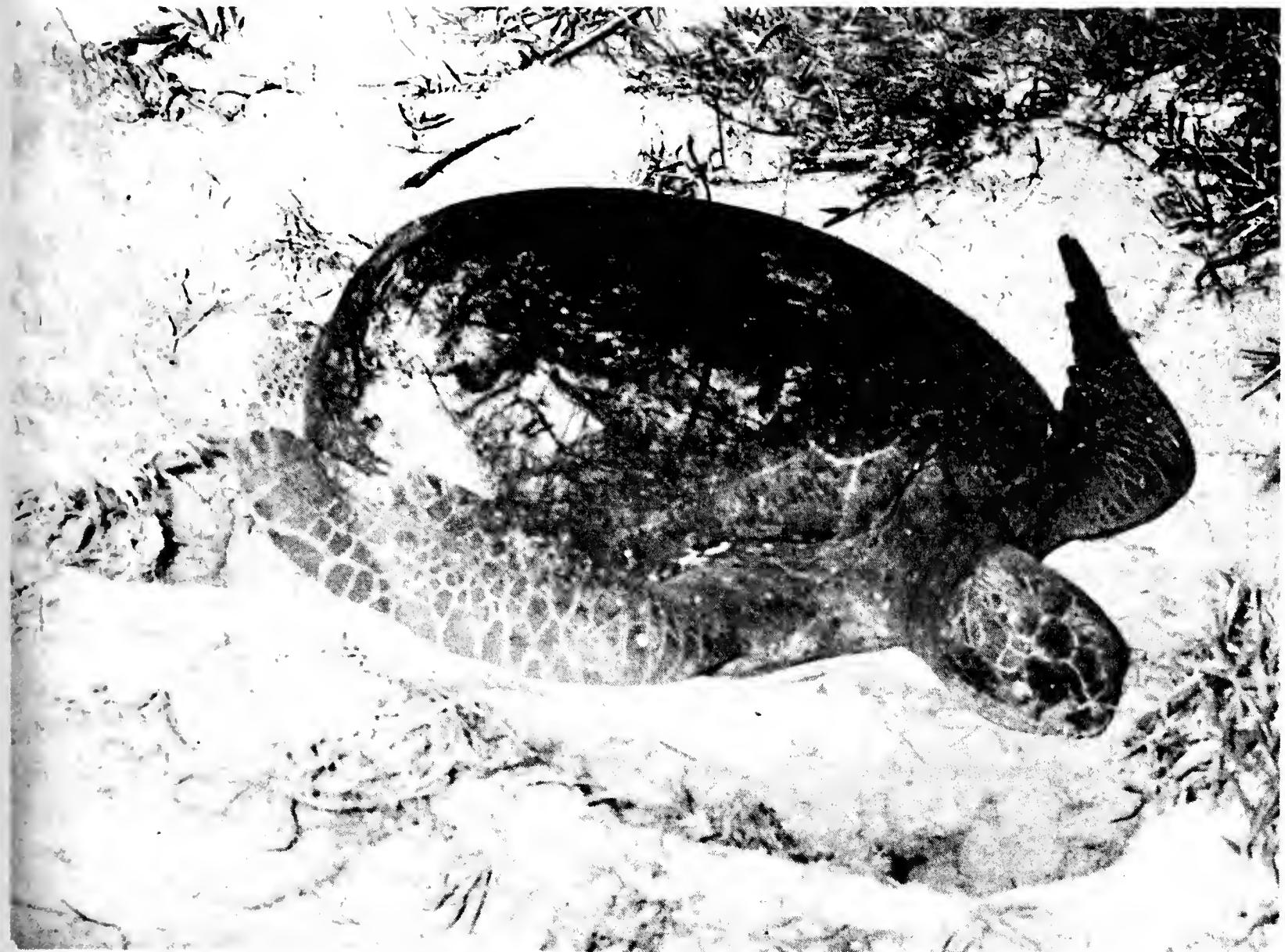


Fig. 7. Female *C. mydas* digging body pit.

meter at Southern Yemen. The distribution of green turtles coincides with the distribution of sea grasses (Hirth, 1971). Offshore of Surinam there is no turtle grass growing, and the number of reptiles existing there is limited and is restricted to mostly juveniles. In the Galapagos *Caulerpa* is eaten. Stomachs of turtles also contain mangrove leaves and roots (Pritchard, 1971). Turtles from the Atlantic coast of Mexico and from the West Indies had eaten in large quantities the turtle grass *Thalassia*. Other vegetable rests taken from stomachs appeared to belong to the genera *Zostera* (e.g. Bermuda and Chile), *Sargassum* (e.g. Pacific coast of Mexico), *Sagittaria*, *Vallisneria* (e.g. Florida), *Cymodocea*, *Ulva*, *Halophila* and others. Adults and sub-adults are not averse to eating animals as well. Some animals may be devoured accidentally together with the swallowing of marine plants. There is a possibility that specimens traveling over long distances from feeding grounds to breeding grounds and back, have to eat animals (e.g. jellyfish) due to a lack of seaweeds. Other marine animals found in turtle stomachs are: sponges, molluscs (e.g. snails) and crustaceans (e.g. crabs). In captivity green turtles can survive on a diet of mixed fishes. Young turtles eat almost any animal they can devour (Burton, 1970). That is not amazing since the species' favorite seagrasses are absent off the nesting beaches.



Fig. 8. Female *C. mydas* digging nest hole.

## MATING

Our knowledge on the sexual behaviour of sea turtles is inconclusive; little is known about courtship and mating. From most species no data are available, but the green turtle is an exception. Some herpetologists succeeded in spending many hours in the sea with mating *Chelonia mydas* pairs and made valuable observations. Mating takes place in the sea, apparently always on the surface (Cogger, 1967). Booth and Peters (1972) report that the mounting of females may occur near the surface of water, but is not necessarily the most frequent place for copulation. Schulz (1968) presumes that mating takes place near the nesting beaches. This is confirmed by Hirth (1971), who says that copulation usually occurs within one kilometer off the nesting beaches. It seems probable that green turtles may reach maturity between 4 and 7 years. Caldwell (1962), mentions 8 to 13 years. Frauca (1970) estimates that females at Heron Island (Australia) become sexually mature when the carapace reaches a length of 35 in (89 cm).

During the breeding season males are continuously prepared to mate, but females are not always sexually aggressive during that period. If a female is not interested in courtship, she will bite the obtrusive male furiously, sometimes causing severe wounds. The biting at the female's neck by the male plays a prominent role in courtship. If she is receptive, the male approaches her from behind. His enlarged claws of the front flippers aid him in grasping the fore edge of the female's carapace. Mating pairs often are escorted by a number of males, circling around the "lovers", and finally one of them will make attempts to dislodge the copulating male. If he is successful, he will try to mate with the abandoned female, but she usually will only accept the original male. The longest continuous observation of a mated pair was 6 hours (Booth and Peters, 1972).



Fig. 9. Laying green turtle on the Great Barrier Reef (Australia).

## NESTING BEACHES

Females breed every 2 - 4 years. They come ashore several times during the breeding season and prefer sandy beaches, which will not be flooded during the spring high tide. The level of ground water must not be too close to the surface of the beach, otherwise the eggs would spoil (Janssen, 1972; Schulz, 1968). A number of nesting sites still exist, but in earlier times one could find nesting beaches of green turtles throughout the tropical world. The most important beaches today are:

- a. South Yemen [almost the year around; peak in November, when 40 or 50 nesting females per mile of beach were observed (Hirth and Carr, 1970)].
- b. Heron Island (Australia) and adjacent islands of the Capricorn and Bunker Groups (mid-November - March).
- c. Bountiful Island, Raine Island, Bramble Cay (Australia) (nesting is somewhat earlier than in the previous areas).
- d. Kamwatta Beach (or Shell Beach), and other beaches at Guyana (March - August).
- e. Eilanti and Bigisanti, Surinam (March - July).
- f. Tortuguero, Costa Rica, the most important nesting site in the Caribbean (June - November).
- g. Beaches of Ascension Island [peak around February (Cronnie, 1971)].
- h. Beaches of West Pakistan, Aldabra Atoll, Thailand, Malaysia, Indonesia and the Philippines [visited the year around (Hirth, 1971)].

Some of the minor turtle rookeries are the beaches of the Galapagos Islands, Tonga Islands, Yucatan Peninsula, western and eastern coast of tropical Africa, West Indian Islands and the Seychelles. A great number of other nesting beaches exist, especially on islands rarely ever visited by man or on islands with less or no natural predators.



Fig. 10. Female *C. mydas* laying her "Ping-pong" ball shaped eggs.

## NESTING, EGGS, HATCHLINGS

Females come ashore to lay eggs on or around the night high tide (Fig. 6). After reaching the beach, the turtle reposes for a while. Possibly to orientate and to examine if the coast is clear; moreover, she presses the head on the sand (Janssen, 1972). The function of this "sand-smelling" is still unknown. She then crawls from surf to the nest site and progresses by laborious forward thrusts in which all four limbs move at once (Bustard, 1968). This is extremely exhausting for the turtle, because of the soft sand. The animals are very shy at this time and will return to the sea immediately upon disturbance (i.e. lights, approaching of people, talking).

After clearing the nest site (preferably a beach platform well above flood tide; Hirth, 1971) a body pit is excavated (Fig. 7). With all four limbs sand is thrown backwards, while the plastron rests on the sand. Occasionally the animal moves forward until a pit is produced somewhat larger than the turtle's body (Schulz, 1968). The depth of the body pit varies from 12 to 20 in (30 to 50 cm). During digging the animal rests repeatedly. After completion of the body pit, she starts excavating the nest hole (Fig. 8). She scoops out the sand beneath the cloaca with her hind flippers and puts it beside the nest. She continues scooping till the nest hole has a depth of about 20 in (50 cm) and a diameter of about 12 in (30 cm) (Somberg-Honig, 1967). If during excavating an obstacle is met (e.g. stone or stub), the whole process is repeated at an other site near by.

The eggs are white and usually dropped one, two or three at a time. The spherical eggs are covered with mucous when leaving the cloaca (Fig. 10) (Hirth, 1971). Egg laying takes about 8 to 12 minutes (Schulz, 1968). Frauca (1973) however, states that this takes 30 minutes to over one hour (Fig. 9). The eggs weigh between 28 and 44 gms each and have a diameter from 40 to 55 mm. Nests contain between 50 and 200 eggs (Frauca, 1970), 48 - 131 (Pritchard, 1971), 70 - 130 (Hirth and Carr, 1970), 137 on an average (Schulz, 1968). Pritchard (1969) reports the average number of eggs per nest at Surinam as 142.8, at Tortuguero 110.0, at Ascension 115.5, and at Sarawak 104.7.

The female covers both the nest hole and body pit with sand and makes her way back at sea (where the males are waiting), leaving behind deep tracks on the sandy beach (Fig. 11). During nesting and covering she may move one ton of sand (Frauca, 1970). The female green turtle spends about 3 hours out of the water when nesting and laying, but this varies and depends on beach conditions. Most green turtles lay between 3 and 7 times each season at about 10 to 16 day intervals (Hirth, 1971). Incubation takes about 7 to 10 weeks, but this depends mainly on climate, season and temperature. In Australia (Heron Island) it takes about 8 to 9 weeks (Bustard, 1968), but at Tortuguero 7 to 10 weeks. Hirth and Carr (1970) mention 48 - 49 days at Abul Wadi Beach (Aden).

Emergence from the sand normally takes place under cover of darkness when predation hazard is greatly reduced. Carapace length of hatchlings varies from 44 to 56 mm. Balazs and Ross (1973), give mean values of 125 one-day-old turtles at the Hawaii Institute of Marine Biology: weight 0.029 kg, carapace length 50 mm, carapace width 36 mm. The movement from

the nest to the surface of the sand is a process that repeats that described for the leatherback, *Dermochelys coriacea* (Zwinenberg, 1974). The carapace of hatchlings is extremely dark (black to dark greenish or dark brownish - Fig. 12). After emergence, the young head for the light horizon (the sea), rush into the sea and swim rapidly to deeper waters. Little is known about the habits of the hatchlings after entering the sea.



Fig. 11. A large crowd gathers as the female heads back to sea.

#### ENEMIES AND TURTLE FARMING

Eggs are dug out and eaten by dogs, foxes, pigs, crabs, rats, monitor lizards and sometimes birds in addition to man. The mortality of hatchlings is high. Approximately less than 1% of them survive to adulthood. Newly hatched turtles have soft shells and are killed by a wide range of predators before they can reach the sea, e.g. by ghost crabs (*Ocypode* sp.), dogs, foxes, raccoons, feral cats, frigate birds (when emergence incidentally takes place at daylight), night herons, rats, mongooses, tigers, jaguars, crows, silver gulls (*Larus novaehollandiae*), monitor lizards (*Varanus* sp.), snakes (*Python* sp.). The few that reach the sea are largely eaten by large fishes, crocodiles and in large numbers by sharks. The stomach of a black-tipped reef shark killed off Australia's coast contained 14 hatchlings (Bustard, 1973).

Adults are killed by sharks too. Many specimens caught at sea or observed on beaches show damages of shark attacks. Except for sharks,

adult green turtles have hardly any natural predators. Only man forms a threat. Mortality is high, as mentioned earlier. Protection is badly needed for obvious reasons. Hatchlings should have a chance to reach adulthood. Green turtle hatcheries operate at different places in the tropical world to help assure their survival. Bustard (1968) collected 30,000 green turtle eggs annually (at a later stage 50,000) from Heron Island for incubation elsewhere under control. After emergence the young are kept in pools for some time [Carr and Ingle (see Peters, 1968) proposed they be kept until they reach shell lengths of 6-8 in (15-20 cm)], tagged and released at sea in several areas. Hatchlings (more than 100,000) are flown from Caribbean beaches (especially from Tortuguero, Costa Rica) to Florida, South America and many other areas for release in hopes to replenishing turtle stocks. In 1968 the Queensland Government gave 5 species of sea turtle full protection, including the green turtle (Bustard, 1969). Full protection for green turtles and their eggs are given at Ascension Island, in Costa Rica, Surinam and Panama. In other areas turtles and eggs are protected only for a number of months, as in Trinidad (from 1 June - 30 September) and French Guiana (from 1 May - 31 August). Green turtles cannot be hunted except under licences, which are hardly ever given, at Sabah, Malaysia (De Silva, 1969). Mexico gives full protection for eggs and allows hunting of turtles during open season. I agree with Hirth (1971), who states that the best and simplest method to secure the green turtle's future is to provide protection for nesting females, eggs, and hatchlings on the natural rookeries, so survival is assured.



Fig. 12. A young green turtle with egg-tooth.

## CONCLUSION

The green turtle is one of the most studied species of sea turtle. We know more about its life history, then of any other sea turtle, and still a number of facts are unknown or need further study. For instance, little is known of the seasonal trips the turtles make between feeding grounds and nesting beaches. Navigation and orientation should be studied continuously, as well as the migration routes. Tagged females from Tortuguero rookeries were recaptured 2400 km away. Others were taken at a distance of 800 km in another direction. Most of these turtles, however, return to the same nesting ground within 2-4 years. How do they manage? Hirth and Carr (1970) tagged some females in southern Yemen, five were later taken off the coast of Somalia. One of them had covered a distance of about 3200 km in exactly 2 years. Ascension Island turtles were recaptures off the coast of Brazil (over 2200 km) and the shores of the Ivory Coast (Africa), about 1600 km away (Fig. 13). Not all turtles travel

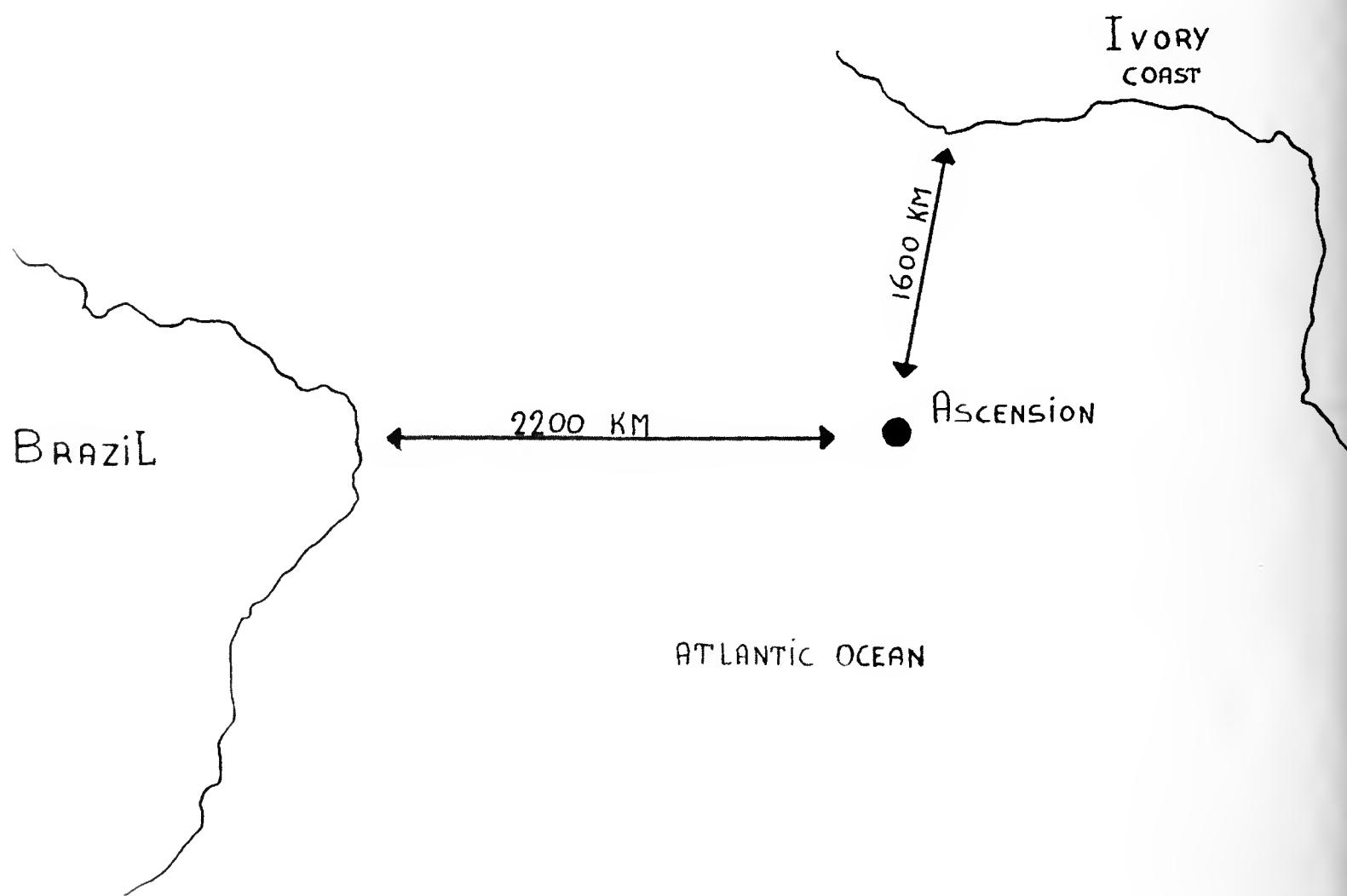


Fig. 13. The migration of green turtles from Ascension Island.

over great distances. A lot are taken within a radius of 100 km of the beach where they were tagged.

We know hardly anything of the hatchlings after they reach the sea. Females do come on beaches after reaching maturity, but males apparently never come ashore, except for some Pacific green turtles (*Chelonia m. agassizii*). In this subspecies it is known that males do occasionally bask on remote rocky beaches. The life span of *C. mydas* is still unknown. The feeding habits are also unclear. These, and a lot of other questions exist, making it clear that research must be continued. The

main concern now, is the immediate protection of *Chelonia mydas*, so that there will be enough time to permit all the necessary investigations, and so that the future of this valuable sea turtle will be ensured.

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## NOTES ON A BROOD OF THE ARIZONA RIDGE-NOSED RATTLESNAKE

### *Crotalus willardi willardi*

The limited number of natural history data and field observations of the ridge-nosed rattlesnake (*Crotalus willardi*) are indicated by the brief treatment given the species in Klauber's monographic review of the genus (1972). Other publications on the natural history of this species are few and brief in context.

On 3 August 1974, I captured an adult female Arizona ridge-nosed rattlesnake (*Crotalus willardi willardi*) at ca. 6500 ft elevation in the Santa Rita Mountains, Santa Cruz County, Arizona. The specimen appeared gravid and was collected with the hope of gathering reproductive data on the species. It was housed in a 2½ gallon aquarium and kept at room temperature, between 23 and 30° C. Fifteen days after capture 18 August, it gave birth to six live offspring and one stillborn which remained enclosed in the embryonic membranes. When I first observed the brood, about 24 hours after birth, the young were coated with dried membrane material from the egg. They were then soaked for several hours in water to remove the dried material. They were weighed on a Torsion Balance about 36 hours after birth and measured after their first molt between 24-29 August. Total lengths, weights and notes regarding food habits of the six offspring and the mother are presented in Table 1.

The coloration of the juveniles differed from that of the mother, who conformed to the general color description of the subspecies (Klauber, 1949). All of the young were distinctly grey and had bright yellow tails, not evident in the mother. The yellow tails faded after the second shed. The basic dorsal pattern of the mother was, however, apparent in the offspring.

Klauber (1949) noted a female *Crotalus w. willardi* that "contained 6 eggs" and a *Crotalus w. silus* that "contained at least 2 well-developed embryos." He also noted the measurements of three juvenile specimens captured in the wild and concluded that they represented the approximate size of the species at birth.

This account, however, appears to be the first confirmation of ovoviparity in this species.

The mother and four of the offspring were released near the collection site on 1 September 1974. Two of the young were retained in captivity for further observations on growth and food intake, and to note their color changes during maturity.

Table 1. Total lengths and weights of a mother and six newborn *Crotalus willardi willardi* with notes on feeding and shedding between 18 August and 1 September.

	Approximate length (nearest 5 mm)	Weight (gms)	Feeding-shedding notes
Mother:	530	65.2 (after parturition)	Killed several small mice but refused to eat them before giving birth. Ate 6 small mice between 18 Aug. and 1 Sept.
Young:	180	5.43	Shed 29 Aug. Refused newborn mice.
	190	5.91	Shed 27 Aug. Refused newborn mice.
	190	6.04	Shed 25 Aug. Ate 1 newborn mouse.
	190	6.06	Shed 25 Aug. Ate 2 newborn mice.
	190	6.39	Shed 25 Aug. Ate 2 newborn mice.
	195	6.66	Shed 24 Aug. Ate 2 newborn mice.

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—Brent E. Martin, 704 N. Second Avenue, Tucson, Arizona 85705.

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# AN OCCURRENCE OF THE ARIZONA RIDGE-NOSED RATTLESNAKE, *Crotalus willardi willardi*, OBSERVED FEEDING IN NATURE

There are several indirect observations on the feeding habits of the ridge-nosed rattlesnake, *Crotalus willardi*, in nature. The following variety of food items have been found in the stomachs of dissected individuals: Van Denburgh (1922) and Klauber (1949) reported finding mammal remains, including small rodents. Klauber (1972) noted lizards (*Sceloporus* sp., *Gerrhonotus kingi*) and a bird, Wilson's Warbler (*Wilsonia pusilla*). He also reported a scorpion disgorged by a *Crotalus w. willardi* in the possession of A. E. Ball. Fowlie (1965) captured an individual of this subspecies that disgorged a centipede several days later. Vorhies (1948), Manion (1968) and Harris (1975) mention lizards as the principal natural food of *Crotalus willardi*, but do not site direct feeding observations. Actual observations of this species feeding in the wild are unknown in the literature.

On the morning of 4 August 1974, I came upon a dead deer mouse (*Peromyscus* sp.) on the ground on an open oak-covered hillside at ca. 6500 ft elevation in the Santa Rita Mountains. Death appeared to have been recent, although the rodent was cold and somewhat stiff. No external injuries were apparent. Suddenly, I was startled by the rattling of an adult *Crotalus w. willardi* no more than two feet away from the mouse and myself. I was completely unaware of its presence until it rattled. As it turned to escape, I captured the snake, which then turned and bit my gloved hand several times. I then released it and after coiling up and continuously rattling for several moments it became quiet and slowly uncoiled, while flicking its tongue and stretching its jaws that were previously displaced from biting. It located the mouse, and began to ingest the rodent's head. When it was halfway down it noticed me move slightly from where I was sitting several feet away; it started to rattle and promptly regurgitated the mouse. When I moved about ten feet away, it stopped rattling and returned to its meal. After eventually swallowing the mouse, it slowly crawled towards a large fallen tree nearby, pausing frequently for several minutes. It then crawled over the tree and coiled up under a space between the fallen trunk and the ground.

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—Brent E. Martin, 704 N. Second Avenue, Tucson, Arizona 85705.

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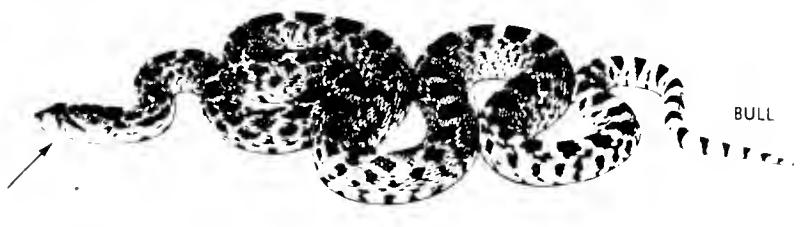
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